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ABSTRACT

This document is a collection of lesson plans written by 18 of Ohio's outstanding teachers chosen by the Ohio Council of Teachers of Mathematics. Each lesson plan includes reflection questions and some contain worksheets. Lesson plan titles for primary grades (grades 1-3) are: "Munching Fractions;" "Math and Literature--Tangrams," "Guests for Breakfast--Measurement and Problem Solving in Real Life Situations," and "Electric Response Board Activities for Math Learning Centers." Titles for elementary grades (grades 3-6) are: Experimenting with Probability," "Money Works," "Geometry Scavenger Hunt," "Chocolate Chip Math--Consumer Math," and "Making a Scaled Map of the Playground." Titles for the secondary level are: "Using Manipulatives in a Cooperative Setting"; "How Tall Is It?"; "Seeing 3-D; "Best Box--Graphic Calculator"; "Creating a Visual Glossary of Dihedral and Cyclic Symmetry"; "Solving Max-Min Problems in Algebra II"; "Displacement, Velocity and Acceleration in Advanced Placement Calculus"; "Area Approximations in Calculus,"; and "Math Students and Doughnuts." Lesson plans, two pages in length, provide: (1) grade level/subject; (2) objectives; (3) materials needed; (4) preparation of materials; (5) directions for use; and (6) reflections of the teacher after using the lesson. (MKR)

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Excellence in Teaching Mathematics:

Activities and Ideas from Ohio's Outstanding Teachers

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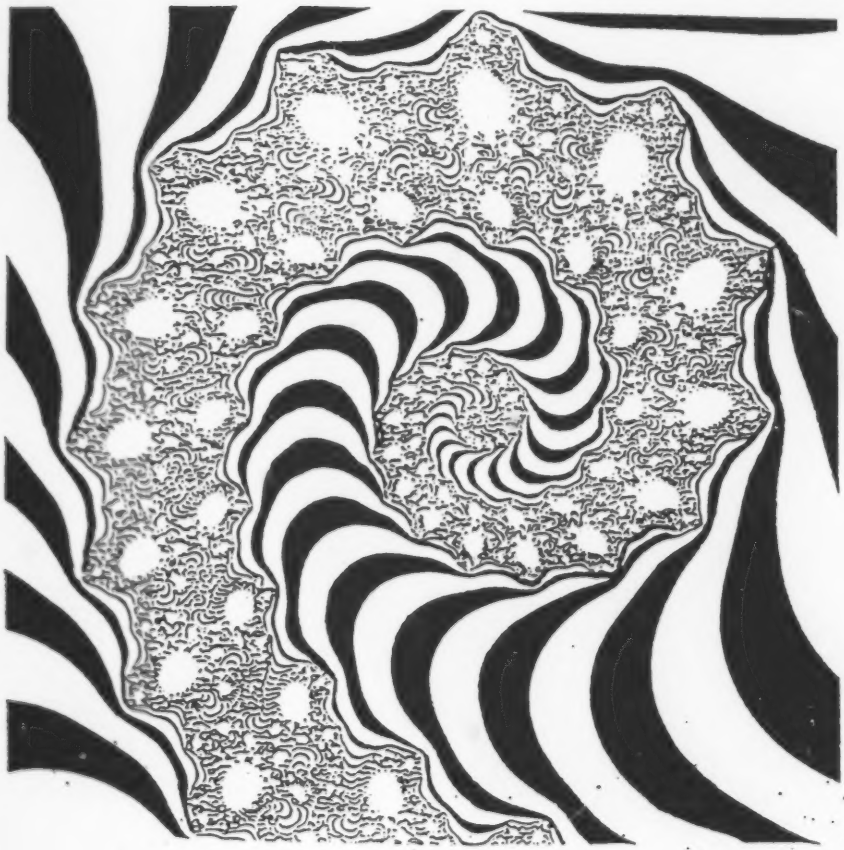

A Joint Effort of the Martha Holden Jennings Foundation and the Ohio Council of Teachers of Mathematics

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About this Project. . .

The Martha Holdens Jenning Foundation and the Ohio Council of Teachers of Mathematics combined to acknowledge twenty of Ohio's finest mathematics teachers. Each teacher was awarded $100 to spend on her or his classroom, materials, or students. The winners were then asked to share their creativity and hard work with others. This collection of lesson plans is the fruit of their efforts. Appendixes contain worksheets that may assist you as you bring these ideas to life in your classroom. These busy teachers not only submitted scripts for a lesson plan, but also took the time to share their wisdom in the form of reflection questions. We salute these teachers and congratulate their efforts!

Nancy Borchers
Joanne Caniglia

Cover Photograph: H.O. Peitgen and P.H. Richter, The Beauty of Fractals, Berlin: Springer-Verlag, 1986, p. 22.

Excellence in Teaching Mathematics:
Ideas from Ohio's Award Winning Teachers

I. Project Background

II. Primary Level
- A. Munching Fractions (Grade 3)
- B. Math and Literature--Tangrams (Grade 3)
- C. Guests for Breakfast--Measurement and Problem Solving in Real Life Situations (Grade 1-3)
- D. Electric Response Board Activities for Math Learning Centers (Grade 3)

III. Elementary Level
- A. Experimenting with Probability (Grade 6)
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- D. Chocolate Chip Math--Consumer Math (Grade 6)
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IV. Secondary Level
- A. Using Manipulatives in a Cooperative Setting
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- F. Solving Max-Min Problems in Algebra II
- G. Displacement, Velocity and Acceleration in Advanced Placement Calculus
- H. Area Approximations in Calculus
- I. Math Students and Doughnuts

Munching Fractions
by
Molly Tharp

Grade Level/Subject: Grade Three

Objectives: The student will:
1. Understand the concept of fractions.
2. Use models to explore fractions.
3. Apply fractions to problem situations.

Materials Needed: Literature Book, Eating Fractions
Graham crackers, Hershey Bars, miniature colored marshmallows, paper plates, overhead fraction circles, and tiles

Preparation of Materials: Obtain book and read to become familiar, buy needed food, obtain overhead manipulatives.

Directions: I would begin my class by reading the book, Eating Fractions or another appropriate book to introduce the concept of fractions as being a part of a whole or a set. We would then discuss this concept. Math journal prompts--"A fraction is....."

Next, I would begin to explore the concept of fractions by using the graham crackers to illustrate wholes, halves and quarters. The Hershey Bars to explore sixths and eighths. The colored marshmallows to determine sets of colors. Then I would introduce denominators and numerators. I might ask them to eat 1/2, 2/6 etc. from these goodies. Math journal prompt: A denominator is..., A numerator is....

Then the children will be challenged to Create-A Snack, (ex. Smores), using the crackers, candy, and marshmallows. After creating the snack they will write the directions in the proper sequence using fractions to describe parts.

As a culminating activity, we would bake M&M cookies, following a recipe, using fractions to measure and amounts of time to bake. Using our cookies we will write fractions for the amount of M&M's in our cookies, based on sets of color. Math journal prompt: How to make M&M cookies.

Follow-Up Activities: We would make a Fraction Layered book using the Dinah Zike or the Ellison Press Designs

Molly Looks Back. . .

1. Describe your students' reaction/response to your selected project.
My students were very motivated. They understand the concept of fractions. Students' responses: "It was cool." "Neat activity." "Learned lots." "I like to eat fractions."

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
Yes, it was a hands-on activity related to the mathematical objective. It was integrated with language arts, art, and real life objects.

3. What if any revisions would you make to your project in the future?
I did plans as stated--we are always changing and adapting to meet our students needs.

4. If you ordered special materials, please give the address and approximate cost of each item.
All items purchased locally.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
Take it slow--develop concepts adequately!

6. Other comments.
This lesson was presented in February and the student's reactions were very positive. Math is fun in my classroom! Thank you for the opportunity!

Math and Literature
by
Barbara Johnson

Grade Level/Subject: Third Grade

Objective: To incorporate children's literature into the math classroom.

Materials Needed: The Tangram Magician by Lisa and Lee Ernst
Grandfather Tang's Story by Ann Tompert
Tangram set for each student

Preparation of Materials: None

Directions: The story of the ancient Chinese puzzle (tangrams) is an interesting one. The prince's favorite tile broke into 7 pieces. Each page contains illustrations of tangrams. Let the children have a period of free exploration with the pieces for a designated time.

Have students make animal shapes with their tangram pieces. See if they can make other shapes also. Have them strive to use all 7 pieces in whatever shape they are forming.

Present the challenge of writing their own story and illustrating it with tangrams. They can work individually or in pairs. I have found that the first time they are usually more successful when they work in pairs.

When their stories are completed, I have each page laminated and then bound into their own published book. (If students work in pairs, have them make 2 copies.)

There are many exciting lessons which can be developed using children's literature as a springboard within the mathematics classroom. Try using a book to introduce each new objective. Your students will love it and so will you.

Barbara Looks Back

1. Describe your students' reaction/response to your selected project.

The students were extremely enthusiastic about the tangram project. They worked well together and did an outstanding job.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?

My students are very familiar with Tangrams and have suggested other ideas for integrating mathematics and literature.

3. What if any revisions would you make to your project in the future?

We extended the lesson. Each student wrote an anthology of short stories illustrated with tangrams.

4. If you ordered special materials, please give the address and approximate cost of each item.

The Tangram Magician by Lisa and Lee Ernst is $19.00.
Grandfather Tang's Story by Ann Tompert is $16.00.
25 sets of Tangrams are $1.10 per set (with shipping) is $30.25.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?

Make sure students have "play" time with the tangrams.

Guests for Breakfast

by

Mary Menchhoffer

Grade Level/Subject: Primary

Objectives: To develop students' skills in measuring and problem solving in real life situations.

Materials Needed: Grocery items, baking dishes, measuring cups and spoons, mixing spoons and storage containers.

Preparation of Materials: Food items need to be purchased and may be measured, preparation, baking, or storage equipment gathered.

Directions: Students will need to decide on a menu they want for breakfast. Choices should include foods from the Basic Food Groups. (suggestions: egg casserole, muffins (made from mix, orange juice). They also need to decide if they want to invite another class.

1. Calculate amount of ingredients needed to make number of servings needed for each food item. How many containers of orange juice are needed to serve each student 4 ounces of juice.? How many boxes of muffin mix are needed? How many muffins do they need to get from each box?
2. Each child writes an invitation to an invited guest. Remember to include R.S.V.P.
3. Compare grocery ads for comparison prices from several stores to get the best prices. Also, gather any coupons that apply. Discuss table manners and how to properly set a table. Make place mats using 12 x 18" sheets of construction paper and placing symmetrical designs for napkins and drink placement. Decide on small groups to make each breakfast food.
4. The day before the breakfast, have students make muffins while language arts activities are going on. Let them do the reading, measuring, and mixing with little adult supervision. Remind them that they must get a certain number of muffins from each batch.

5. Have the students make the egg casserole. At the same time the orange juice committee can be preparing the frozen orange juice.
6. On the morning of the breakfast students need to set the table for themselves and their guests. They greet their guest at the door and seat him/her at their places. Finally they serve their guest and themselves.

Follow-Up Activities: After the breakfast and clean-up, list the items bought and their prices. Using calculators, children will find the actual cost of the breakfast. The entire class can also write thank-you notes. Note: You are not limited to breakfast or inviting another class. A luncheon for mothers or a salad bar lunch for the class are options.

Mary Looks Back. . .

1. Describe your students' reaction/response to your selected project. The children felt very grown-up being able to make decisions. The responsibility given to them in making the muffins, etc., required co-operation and a need for checking their measurements. I could see the pride on their faces when they seated their guest and served them.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not? The children found that if they didn't measure carefully that the muffins wouldn't come out right. Yes, we did have a couple of batches that were flops. We discussed why this might have happened. They realized that maybe they put too much milk in or filled the muffin cups too full. They found that in real life you have to measure accurately. When we calculated the cost of the meal the children were surprised to find out how much food really costs.

3. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated? Teachers who try this might want to have a mother to come in to oversee the mixing and baking of the muffins. It keeps the mess to a minimum and helps the project to flow smoothly. I took the children making the egg casserole and orange juice to the kitchen during the afternoon recess.
The first graders were so excited! Many skills were developed through this project.

Electric Response Board Activities
for Math Learning Centers
by
JoLene Shafer

Grade Level/Subject: Third Grade

Objective: To encourage children to discover basic concepts on their own through manipulation and experimentation. To provide the children with immediate feedback on their performance.

Materials Needed: Dry cells, transistor radio batteries, cell holders, lamps, lamp sockets, round-headed machine screws, paper fasteners, wire, probes, alligator clips, peg board, heavy cardboard or corrugated boxes, plastic pockets, file folders, and containers.

Preparation of Materials: The electronic response boards will be created with the above materials with a variety of activities to meet individual needs as well as to enrich others. The boards will be designed to allow for easy changing of skills presented. The electric boards will be categorized and stored in labeled containers.

Directions: Each child will have an individual journal. A check off record sheet will be placed in front of the journal to help the child and teacher to know which skills have been completed. The children can work alone or with others depending on the tasks presented and then record findings in their journals.

The electric response board works on the simple series circuit theory. For example, when probe "A" touches one end of the circuit wire attached to a skill, and probe "B: touches the other end of the circuit wire attached to the other skill, the circuit is complete, the lamp lights up, and the child knows he has chosen the correct answer.

The boards provide a program that works in conjunction with attached skills. The problem or activities are on one side and the answers on the other.

Follow-up Activities: Provide materials and directions for the children to create individual electric response boards.

JoLene Looks Back

1. Describe your students' reaction/response to your selected project.
The children were highly motivated and excited with the boards. They preferred the activities presented and the challenge of solving the problems and getting the boards to light up to other hands-on activities including the computer.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
The activity gave the children an opportunity to experiment and explore with continuous personal involvement, and presented activities to individualize and personalize instruction with immediate feedback. Learning became more like a game.

3. What if any revisions would you make to your project in the future?
Create and provide an electric board for each child. Twelve boards were created with six activities for each board. I soon found myself constructing more activities because of the overwhelming demand for the center.

4. If you ordered special materials, please give the address and approximate cost of each item.
None.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
Materials selected to create the boards should be durable. File folders and poster board are too light weight. Corrugated boxes purchased at Office Depot worked well. After using the boxes, I discovered that discarded binders were usable and protected the wiring. You quickly discover that batteries are "gold". Rather than continually purchasing batteries, I ask for donations from parents. The local pizza restaurant donated pizza boxes.

Experimenting with Probability
by
Catherine Shambaugh

Grade Level/Subject: Sixth Grade

Objective: To investigate probabilities for the possible outcomes of a simple experiment.
To make predictions of outcomes of experiments based on theoretical probabilities and explain actual outcomes.

Materials Needed: Pennies--one per student; spinners--"fair" and "unfair" , one for each small group; dice--one per student; M & M's-- fun size packages, one per student; variety of books.

Preparation of Materials: "fair" spinner should be divided into four equal sections with each section colored a different color. "Unfair" spinners should be divided into four sections unequally and colored.

Directions:

1. Begin with students playing a few rounds of "Hangman" or "Wheel of Fortune". Discuss which letters of the alphabet they chose first, and why. Have the students examine books to see if their reasoning seems correct.
2. Discuss the probability of heads vs. tails on a penny flip. Have entire class flip a penny once and see if the actual outcome is 1/2. In partners, have students flip a penny 10 times and record the results. Discuss the outcomes. Predict what will happen if you flip the penny 100 times. Do so and discuss the outcomes.
3. In small groups, have the students experiment with "fair"spinners. What is the probability of spinning "red"? How many times do you need to spin to test your prediction? Next, do the same using "unfair"spinners. compare and discuss the results.
4. Give each student a die. Discuss the probability of rolling any number. With partners, students play a game: taking turns, each student rolls two dice and adds the numbers that come up. Player 1 scores if his/her sum is 2,3,4,10,11, or 12. Player 2 scores if his sum is 5,6,7,8, or 9. (Player 1 does not score if Player 2 rolls one of

his/her sums.) The first person to score ten points wins. Have students predict who will win and explain their answers. Have the students play several times and discuss the results. Before playing most students will expect Player 1 to win because he has more sums, however, Player 2 will usually win because of the numbers involved. Have the students work in small groups to figure out why.

Cathy Looks Back

1. Describe your students' reaction/response to your selected project.
The students' responses were quite positive. They said things like, "Why can't we play games all of the time," I reminded them that we weren't "playing games," but rather we were conducting mathematical experiments.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
I feel the activity was very helpful in that the students were creating their own data and applying directly what was being taught. Students related to me that they now understood better strategies when playing some games.

3. What if any revisions would you make to your project in the future?
I taught these lessons over 3 days. I would allow more time.

4. If you ordered special materials, please give the address and approximate cost of each item.
Spinners (16 sets @ $4.95=$79.20), Iscosahedreon dice $4.95; Shipping 8%. Total: $90.88. Cuisenaire Co. of America, Inc., 10 Bank St. PO Box 5026, White Plains, NY 10602-5026.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
A few students may try to manipulate the results Discuss the importance of valid experiments and protocols when conducting research or doing experiments.

Money Works
by
Oretha M. Rose

Grade Level/Subject: Third--Fourth Grade

Objective: To enable children to count money through $20.00 and count back change up to $10.00

Materials Needed: Play money including coins and bills, brown envelopes, hundred's chart, paper clips, overhead projector, transparency of hundred's chart, coins and bills for overhead projector.

Preparation of Materials: Take the brown envelope and glue the reduced hundred's chart on the front. Shade the multiples of five in yellow and circle the multiples of twenty-five in red. Put a paper clip, four pennies, two nickels, two dimes, three quarters, four - one dollar bills and one-five dollar bill in each envelope. One of these packets is needed for each student. Use the Overhead Projector with the Hundred's Chart transparency to demonstrate how to count money and count back change using the coins and bills for the Overhead Projector.

Directions:

Display the transparency on the overhead projector. Give each student a brown envelope with the coins and bills. Give them a problem. For example, James bought a cassette at the store. He paid $5.21 for the cassette. He gave the clerk $10.00. Count back his change. Put the paper clip on 21. What coin will get us to 22, 23, 24, 25? They now have four pennies on the chart. What coin will get us to 50? The students will respond $0.25. What coin will get us to 75. The students will respond $.25. What coin will get us to 100? The students will respond $.25. The change brings us to how much? The students will respond $6.00. What would get us to $7.00? The students will respond $1.00. What will get us to $8.00? The students will respond $1.00. What will get us to $9.00? The students will respond $1.00. What will get us to $10.00? The students will respond $1.00 The children will say $5.21, $0.01 makes $5.22; $0.01 makes $5.23; $0.01 makes $5.24; $0.01 makes

$5.25; $0.25 makes $5.50; $0.25 makes $5.75; $0.25 makes $6.00; $1.00 makes $7.00; $1.00 makes $8.00; $1.00 makes $9.00 and $1.00 makes $10.00. I have the students write the price of the cassette $5.21 and then copy what they have on their chart. $5.21-$0.01, $0.01, $0.01, $0.01, $0.25, $0.25, $0.25, $1.00, $1.00, $1.00, $1.00.

Oretha Looks Back

1. Describe your students' reaction/response to your selected project.
The students enjoyed these activities tremendously. They ask to do these activities over and over.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
Yes, these activities reinforced the mathematical objectives. The children were able to count money through $20.00 and count back change through $10.00. The children also learned to work cooperatively during this activity.

3. What if any revisions would you make to your project in the future?
I would not make any revisions in the project. It worked very well.

4. If you ordered special materials, please give the address and approximate cost of each item.
Play money (Media Material, 1985) $40.00
Coins and bills for the Overhead Projector (Creative Publications) $9.95. Brown Envelopes; Overhead transparencies $15.00.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
I really didn't have any problems. Everything went very well. The children were eventually able to move from the concrete level to the abstract level of counting money and counting back change.

Geometry Scavenger Hunt
by
Barb Weidus

Grade Level/Subject: Fifth Grade

Objective: To encounter and use appropriate vocabulary relative to circles, polygons, etc.
To build models of previously encountered shapes and figures and describe the process in words.
To search for patterns and explanations in natural phenomenon.

Materials Needed: Polaroid, baggie, pencil, list, clipboard

Preparation of Materials: One Polaroid with one roll of film per group, one Baggie per group (gallon size), typed list of items to find/draw, pencil attached to clipboard (to check off items on list).

Directions:

This project is a summation of the students' study of geometry. The students will receive a list of items to find in the classroom or outside the building but on the school grounds. A time limit of 30 minutes will be given. Deductions per minute late will be given! Students will draw, find, and take pictures of everyday items in their school environment. Points will be assigned to each item on the list. Points will vary based on difficulty in finding certain items. Winning team will receive a prize.

Examples from the list would include finding two circles of varying sizes, something with one line of symmetry, etc.

If students draw the item, they will receive 5 points.
If students bring in the item, they will receive 15 points.
If students take Polaroids of the item, they will receive 20 points.

Follow-up Activities: In journals, explain what you learned from this experience. What did you enjoy? What seemed impossible to find? What might you change on the list?

Barb Looks Back

1. Describe your students' reaction/response to your selected project. The students were extremely excited about going outdoors to find their geometric terms. The camera added extra excitement and interest.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
Yes. It opened their eyes to look at all things in nature mathematically not just from workbooks, math books, etc. It made them more visual also.

3. What, if any revision would you make to your project in the future? Definitely I would ask parents to help with each group. The students got wound up and forgot some of the rules.

4. If you ordered special materials, please give the address and approximate cost of each item. Polaroid cameras--Service Merchandise $27.98; film--Sams 35.52,;Service Merchandise $19.97.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
It might also take one class period to set up, one to do and one to share. So plan for 3 class periods.

6. Other comments. Thank you for giving me this opportunity to enhance my mathematics classroom!

See Appendix for Barbara's Geometry Scavenger Hunt handout.

GEOMETRY SCAVENGER HUNT

Dear Contestants,

This is race against time. You need to gather more points than the other teams. You must stay together at all times. You may use the classroom, hallways, schoolgrounds, and trail to collect your items. The following items should be in your possession:

A Polaroid with film
A watch
An envelope with the items listed below: (Do NOT open yet.)
- an arrow
- a pencil/pen
- a "to find" list
- drawing paper

You may take pictures or draw or build the item on the list. A team member and arrow must be clearly showing in each photo to get credit. On pictures, draw an arrow pointing to the figure.

BE CAREFUL AND QUIET!

TIME LIMIT: You will have 30 minutes. If you are not back in 30 minutes, you will receive a 5 point penalty for each minute you're late. Example: If your team is 5 minutes late, your team receives a 25 point deduction.

BONUS: If you catch another team taking a picture of the same item on the list as you already did, take a picture of them and get an extra 50 points.

WARNING: Watch how much film you have left. Use wisely!

GEOMETRY SCAVENGER HUNT

Important Do's:

At least one team member with the arrow must be in every photograph.

The arrow must be pointing to the figure that you want credit for.

To save time and film, you may have more than one figure in your picture.

Catch another team photographing the same figure that you did. Take their picture doing it to earn an extra 50 points.

Geometry list:	Points:		
1 pair of intersecting lines	5	10	15
1 triangle	5	10	15
1 rectangle	5	10	15
1 line of symmetry	5	10	15
1 circle	5	10	15
1 acute angle	5	10	15
1 obtuse angle	5	10	15
1 right angle	5	10	15
1 rectangle with message on it	5	15	20
1 pair of parallel lines	5	15	20
1 pair of perpendicular lines	5	15	20
1 square	5	15	20
2 lines of symmetry	5	15	20
1 right triangle	5	15	20
2 congruent figures	5	15	20
1 hexagon	5	15	20
1 pentagon	5	15	20
1 equilateral triangle	5	15	20
2 similar figures	5	20	25
1 trapezoid	5	20	25
1 rhombus	5	25	30
1 irregular polygon	5	25	30
1 triangle with an obtuse angle	5	25	30
1 circle with a 6 inch diameter	5	25	30
1 triangle with an acute angle	5	25	30
1 - 180 degree angle	5	25	30

Barb Weidus
C.D. Harrison Elementary
9/94

Chocolate Chip Mathematics
by
Patricia (Trisha) Prunty

Grade Level/Subject: Sixth Grade

Objective: To provide problem solving, application of math skills with everyday objects.
To excite students in the area of mathematics.

Materials Needed: Different types of cookies (chocolate chips), measurement devices, calculators, graph paper, pie graph bead circles, large poster board for graphs, cookie math packet for each group.

Preparation of Materials: Materials should be grouped in packets for each activity.

Directions:

Activity #1: Each group of 4 students will be given a bag of cookies to determine the cost per cookie. As a group will make a large graph illustrating the cost of each bag.

Activity #2: Each group will be given one of each type of cookie to weigh and measure and chart according to size.

Activity#3: Each group will be given a sample cookie from each bag. As a class we averaged the amount of chips in each test group and graphed in a bar graph the chips in each type.

Activity#4: Large group setting brainstorm the aspects of a good cookie. Then we will develop criteria for a taste test. After rating the different chocolate chip cookie brands, students will create a pie chart of their favorite cookies.

Activity #5: Using all graphs and data each student will write a summary of consumer's advice on choosing the best chocolate chip cookie.

Follow-up Activities: We shared our graphs by displaying them and our essays in the hallway. We also discussed packaging and advertising aspects of products. The term generic was also discussed.

Patricia Looks Back

1. Describe your students' reaction/response to your selected project. My students loved the cookie math presentations. We discussed many aspects of consumer education, math, language arts, and the scientific method.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
Yes. For example, Chips Ahoy claims 1,000 chocolate chips in the cookie bag. The group that had this product figured the bag contained more than 1,200 chips.

3. What, if any revision would you make to your project in the future? I would spend the entire day with the project instead of four math class periods. We had difficulty stopping due to time constraints.

4. If you ordered special materials, please give the address and approximate cost of each item. Polaroid cameras--Service Merchandise. I bought several scales. The students brought in the different types of cookies.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
The cookies might disappear or grow stale.

Making a Scaled Map of the Playground

by

Virginia Kerr

Grade Level/Subject: Grade 4; Math, Social Studies, and Language Arts

Objective: To use a variety of tools to measure the playground and equipment.
To understand when to use each type of measuring tool.
To complete a scaled map of the playground.

Materials Needed: Meter sticks, rulers, measuring wheel, graph paper.

Preparation of Materials: None.

Directions:

Day 1

Groups of children will measure different areas of the playground, the perimeter of the playground, perimeter of each piece of equipment. They will make a large unscaled drawing of the playground. They will decide which symbols to use for the equipment.

Day 2

Groups will brainstorm final size of the map. Which scale will work best? Do we want it the size of 1 paper, or several papers taped? How will we determine where to put the equipment on the map? Make perimeter of map to scale. Make models of the equipment symbols to scale.

Day 3

Groups work deciding how to determine where to place equipment. Remeasure the playground to determine the distance the equipment is away from the other equipment. Make symbols on the map. Make final drawing.

Follow-up Activities: Fourth graders must do a lot of map work in their study of Ohio History. This lesson will directly tie in with map reading in Social Studies. They will be using maps to determine road mileage as well as scale miles to places. It will also tie in with language skills, because I plan to have the children write to different Chambers of Commerce to get information about the history, industry, population, etc. They will then develop story problems comparing and contrasting the different areas.

Using Manipulatives in a Cooperative Setting
by
Pamela Givens

Grade Level/Subject: Pre Algebra

Objective: To facilitate the understanding of various geometric shapes through tangram constructions and centimeter cube constructions in a cooperative group setting.

Materials Needed: Tangrams, tangram patterns, centimeter cubes, Get It Together worksheets, envelopes.

Preparation of Materials: Duplicate tangram patterns, Get It Together worksheets, prepare baggies containing the correct centimeter cubes, put cooperative worksheet clues in envelopes.

Directions:

Hand out tangrams and tangram pattern sheets. Students are to complete the patterns individually, given about 15 minutes. At the conclusion of this time, solutions are shared and discussion about the activity takes place. Next, students get into their pre-determined cooperative groups. Review group roles and hand out cubes and envelopes, review meaning of "face", "edge", and the concept of "surface area". Explain the rules of the activity:

1. Everyone is to read their clues to the group
2. One shape will be built for each set of clues
3. After each shape is built the group is to call the teacher over to verify the shape

At the conclusion of the time allotted for each shape, discussion will occur regarding the solution and the next set of clues will be handed out for the process to continue.

Follow-up Activities: Textbook sections involving areas and surface area will be studied following this activity.

Pamela Looks Back

1. Describe your students' reaction/response to your selected project. The students enjoyed the activity with the centimeter cubes and tried to be the first group to solve the problem. The tangram project was not as successful as some students became frustrated when they were unable to make the required shape.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
I think this activity helped students visualize the concept of "face", "edge" and "surface area" much better than simply drawing examples on a chalkboard. The tangram activity gave the students the opportunity to explore various shapes and how to match congruent lengths to make larger segments and shapes.

3. What, if any revision would you make to your project in the future? I don't think I would do anything differently with this lesson in the future.

4. If you ordered special materials, please give the address and approximate cost of each item. All of my materials were ordered through Creative Publications:

a.	Centimeter Cubes	1000 for $30.00
b.	Get It Together	30 sets for $26.50
c.	Tangrams	30 sets for $26.50
d.	Tangram Patterns	$15.50

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
Some students are unwilling to work in cooperative groups and let the other group members do all the work. Prior orientation to cooperative group learning should help alleviate some of these concerns. Another consideration would be to prepare the baggies of cubes as I have described to avoid undo confusion during the activity itself. The cubes do tend to slide off desktops easily.

6. Other comments.

Copies of Pamela's worksheets are not provided in the Appendix. (Get it Together sheets are copyrighted and are unable to be reproduced.)

How Tall Is It?

by

Pat Jungkeit

Grade Level/Subject: Geometry/9-12

Objective: To use similar triangles and trigonometric ratios to compute the approximate height of the school smokestack.
To use outdoor measurement to collect approximate data.
To use computer technology to create experimental heights and use statistical analysis to predict the actual height of the stack.
To connect all phases of the project by creating a complete report on the computer.
To communicate the results of their project to the class.

Materials Needed: A tall structure near the school (I use our building's smokestack, but a tree or other structure would work just as well.) 50' or 100' tape measure, mirrors, clinometers (these can be "homemade" with cardboard, straws, and string.) computers, software including spreadsheets, word processing, and graph/chart capabilities.

Directions:

Students should work cooperatively with a partner for the project.
Students should be encouraged to treat the project as a bid for a corporate contract.
It is important that they measure carefully and calculate accurately. However, it is equally important that they communicate their findings in a convincing and appealing manner.

In the Classroom.

1. Explore the connection between light reflection in a mirror and similar triangles. Discuss how the triangles might be used to calculate heights.
2. Explore the use of shadows to create similar triangles that can also be used to determine approximate heights.
3. Explore angles of elevation, and use them with the tangent function to calculate heights.

4. Have each team estimate the height before beginning the experiments.
5. Challenge students to discover a new method for determining the height of the stack.

Before going outside, give the students careful instructions about the expectations and goals of the experiment.

Outside

1. Mirror Experiment: (minimum of 4 locations)
   Place mirror flat on the ground. Measure the distance from the stack to the mirror. Slowly move back from the mirror until the top of the stack is visible in the mirror. Measure the distance from the mirror to the person who has sighted the stack. Measure the height of the person (to eye level). Record all data.
2. Angle of Elevation: (minimum of 4 locations)
   Use the clinometer to sight the top of the stack and record the angle. Measure the distance from the stack to the person doing the sighting. Record the height of the person (to eye level).
3. Shadow Experiment: (minimum of 2 data sets)
   Align your body so the top of your shadow matches the top of the shadow of the stack. Measure the length of your shadow and the length of the stack's shadow. Record your height. Each partner should do this.

The Computer Laboratory

1. Each pair of students will create a spreadsheet that clearly displays their data and incorporates algebraic formulas to calculate the experimental heights for each of the experiments.
2. Using the experimental heights, students will find the measures of central tendency, create charts and or graphs, and use statistical reasoning to decide on the best estimate of the height. Outliers should be discussed.
3. A formal report will be created on a word processor to connect all the phases of the project. It should include: a cover page; an explanation of each experiment, with drawings, labels and formulas, spreadsheets; charts or graphs, statistical data, and a conclusion containing the estimated height of the smokestack.

See Appendix for worksheet.

Smoke Stack Project
130 points

Names_____

I. Cover and overall appearance of report (5) _____

II. Conclusion and observation
- Height and how decision was made (10) _____
- Reasons for inaccuracy (5) _____
- Special observations/elimination of data (5) _____

III. Spreadsheet

Mirror Experiment
- Picture and visual appeal (5)
- Explanation or formulas (5)
- Calculation accuracy (10) _____

Angle of Elevation
- Picture and visual appeal (5)
- Explanation or formulas (5)
- Calculation accuracy (10) _____

Shadow Experiment
- Picture and visual (5)
- Explanation or formulas (5)
- Calculation accuracy (10) _____

IV. Statistics (10) _____

V. Chart/Graph (10) _____

VI. Oral Presentation (25) _____

Total _____

Seeing 3-D
by
Joan Hubler

Grade Level/Subject: Geometry

Objective: To allow students to build a 3-dimensional object and to answer appropriate questions concerning points, planes, and lines.

Materials Needed: Tinker Toys, Worksheets

Preparation of Materials: Prepare Worksheets

Directions:

Students were divided into groups of 3 or 4. Each student had their own worksheet and each group had a container of tinker toys. Following the directions on the worksheet, each group constructed a 3-dimensional object of the figure shown on the paper. Next they proceeded to answer the questions.

Follow-up Activities: The tinker toys will be used to construct 3-dimensional figures when working with area and volume.

You can find Joan's worksheet in the Appendix.

Joan Looks Back

1. Describe your students' reaction/response to your selected project. The students were surprised when I mentioned they would be using tinker toys for their assignment. It sparked their interest and aroused their curiosity. They enjoyed the activity and real learning was going on.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
The activity was a great cooperative learning experience. The 3-dimensional objects enabled students to have an object to turn and to use to answer the questions. Because of the hands-on opportunity, the activity was helpful to reinforce the mathematical objectives.

3. What, if any revision would you make to your project in the future? The revision that needed to be made was on the worksheet. the submitted worksheet reflects the revision.

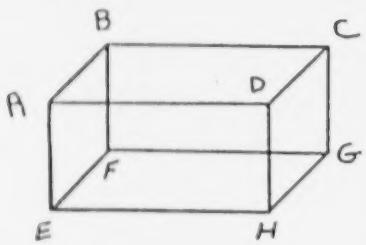
4. If you ordered special materials, please give the address and approximate cost of each item. Tinker toys were purchased at local discount centers.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
Students do have the tendency to just play with the tinker toys. The objectives of the lesson need to be stated and some students need to be reminded of them throughout the class time.

6. Other comments.
The students had fun with the activity and learned a lot. Most of the students had their hands on the object to help answer the questions. Some students have difficulty looking at a picture in the book and answering these type of questions.

Name _____

Construct the following diagram. Label all the points.



1. Are points A, B, C collinear?
2. Are points B, C, F coplanar?
3. Name the plane of the front face.
4. Name the plane of the bottom face.
5. Name 4 coplanar points.
6. What is the intersection of the top face and the back face?
7. What is the intersection of the right face with the bottom face?
8. What is the intersection of $\overleftrightarrow{AB}$ and $\overleftrightarrow{CB}$?
9. Point G is the intersection of what lines?
10. How many different planes contain point F?
11. Does plane BCF contain D?
12. Does plane ABF contain E?

Add Point P to the bottom face.

13. $\overline{DC}$ is the edge of dihedral angle _____.
14. $\overline{BF}$ is the edge of dihedral angle _____.
15. Name all dihedral angles that have P on the face.
16. Dihedral angle E-$\overleftrightarrow{AD}$-B has plane angles _____ and _____.
17. $\angle ABC$ is a plane angle of dihedral angle _____.
18. $\angle EHD$ is a plane angle of dihedral angle _____.
19. $\angle FGH$ is a plane angle of dihedral angle _____.
20. What is the intersection of dihedral angles A-$\overleftrightarrow{DH}$-C and F-$\overleftrightarrow{CG}$-H?
21. What is the intersection of dihedral angles C-$\overleftrightarrow{AB}$-F and A-$\overleftrightarrow{EF}$-P?

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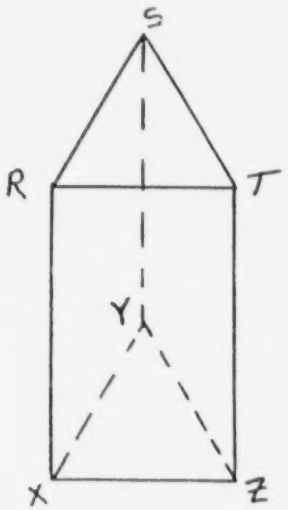
Construct the diagram. Use 2 red sticks and 1 purple stick to construct $\triangle RST$ and $\triangle XYZ$. Label all the points.



22. $\angle RST$ and $\angle XYZ$ are plane angles of what dihedral angle?

23. What is the measurement of $\angle RSY$?

24. $\overleftrightarrow{YZ}$ is the edge of dihedral angle _____.

25. How many dihedral angles are in the figure?

26. What is the intersection of dihedral angles $R\text{-}\overleftrightarrow{SY}\text{-}T$ and $S\text{-}\overleftrightarrow{XY}\text{-}Z$?

The Best Box

by

Henry Cooke

Grade Level/Subject: Sixth Grade

Description of Project:

You have been promoted to production manager of a company that makes boxes to sell to commercial shippers. When you arrive on the job you receive a call from your best customer who wants one thousand open top boxes for storing old 5 1/2 inch floppy discs until they come back into style (It happened with wide ugly ties you know). When you contact the person who sells your company the sheets of cardboard, he tells you that he has a special on the size sheets that you have on your desk.

Objective: To find the best box that students can make from a given sheet of cardboard. The best box is the one that will hold the most.

Materials Needed: per group

1 pair scissors
1 sheet of cardboard or construction paper
Scotch tape
1 sheet of 1 cm graph paper

Instructions:

Note--You will receive only one sheet of cardboard or construction paper, so make sure your data is correct before you do any cutting!

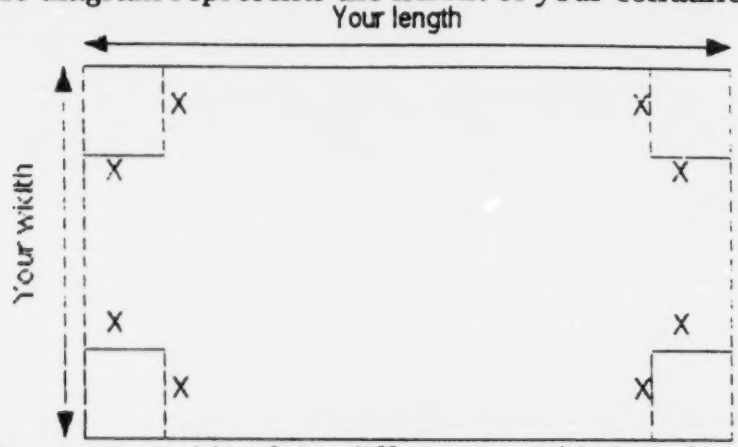
Directions:

1. You will work in your cooperative group as a team to solve this manufacturing problem. You should first recall how to find the volume of a rectangular solid, and write it down. If you don't remember, LOOK IT UP!

Question 1: What is the formula for finding the area of a rectangular solid?

Question 2: What are the dimensions of your cardboard sheet in inches?

2. You will find that you eventually will cut a square from each corner of the cardboard so you can fold up the sides of the box. The X in the diagram represents the height of your container.



3. Construct a table of the different possible lengths, widths, heights, and resulting volumes. You will find that although you have no control over the size of the piece of cardboard, some dimensions will result in a larger volume than others. You should work until you find the largest volume to the nearest hundredth of a cubic inch.

4. After you have completed the table, choose a reasonable scale for a graph and use the table to construct a graph of volume vs. height (x). Remember that the independent variable should be on the horizontal axis and the dependent variable should be on the vertical axis. Axis should be labeled. Graph paper is available.

5. Construct the box that your data indicates would result in the larges volume.

6. Write the names of each person in your group in the bottom of the box. Fold and place your assignment in the box and turn it in to me. Make sure that all names are on each part of the assignment--graph, table, and questions.

Question 3: Give three reasonable values for X for your project. (Any that you used to find volumes.)

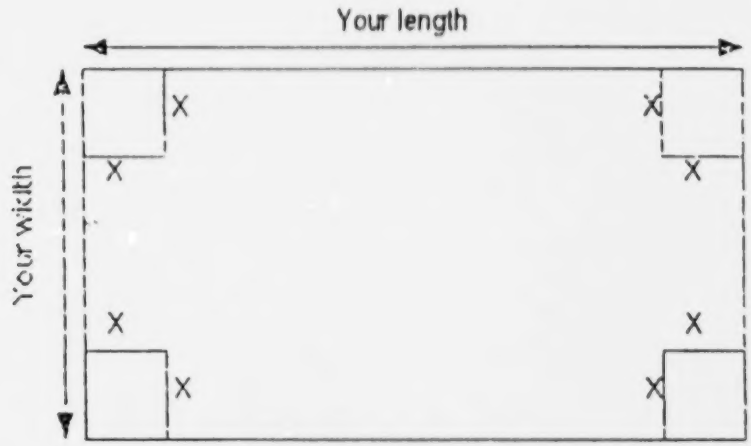
Question 4: Give three values for X that would not be reasonable. Explain why each would not be a reasonable value.

Question 5: Which variable was independent? Which was dependent?

You can find Henry's worksheet in the appendix. (It is the one that uses the least amount of paper!)

GRAPHING CALCULATOR EXERCISE
THE BEST BOX

The volume of a rectangular solid is found by multiplying length times width times height. $A = L * W * H$. Refer now to the the diagram below.



Let us say for an example that the size of my sheet of cardboard is 10 " wide by 8" long. Then after I fold up the sides of my cardboard to form a box, the dimensions of the box should be length = 8 - 2X, width = 10 - 2X, and height = X. If I put these dimensions into the volume formula I have V = L * W * H = (8 - 2X) (10 - 2X) (X). Your assignment today is to graph this relationship on the TI - 81 graphing calculator.

Sign out a TI - 81 from your teacher.

1. Turn on the calculator

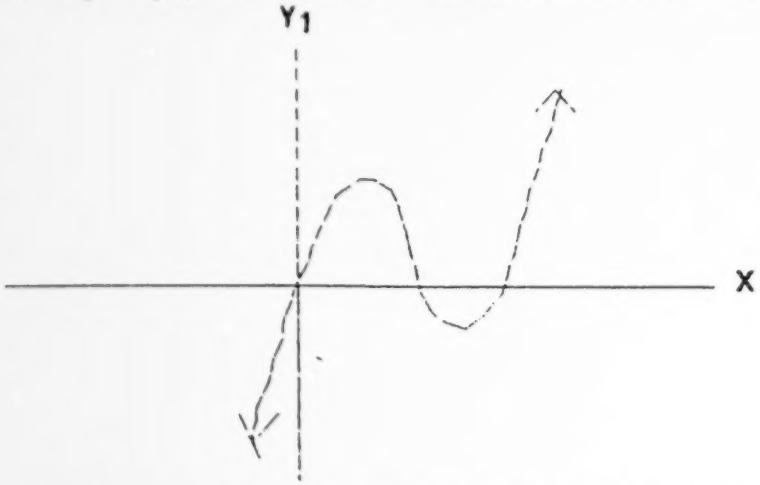
2. Press **[Range]** to set the range of values for the independent variable and the dependent variable. Refer to your table of values

3. Press **[Graph]**. This is where you will write the equation for your box – or create your math model. Do not be alarmed by all the $Y_1, Y_2, Y_3 \ldots$ stuff. The calculator will graph several equations on one graph, but we will only be constructing one graph, so we will only use Y_1.

4. Write the equation for your box. Pressing **[Clear]** will clear the entire screen. Using the arrows to move the cursor will allow you to edit. In the case of my example above, I would write

$Y_1 = (8 - 2X)(10 - 2X)(X)$. Please notice that I have used Y_1 for V (volume) since the calculator uses X as the independent variable and Y as the dependent variable.

5. After you have written your equation onto the calculator, press **[Enter]**. You should get a graph that looks like the one sketched below, or at least some part of it.



6. Use **[Trace]** to follow the graph and notice the X and Y values on your screen. The right arrow will move the cursor to the right and the left arrow will move the cursor to the left.

7. Using the trace function of the calculator, compare the results of your "Best Box" project to the graph.

Question 1. How do the results of your "Best Box" project compare to the what you found when you traced the graph?

Question 2. I notice that on the graph, the farther I go to the right, the larger the volume (Y_1) is. Why do I look at only the part of the graph that looks like a "hilltop" when I am finding the best volume?

Question 3-a. Write the equations for the best box that can be made from a sheet of cardboard that is 24 inches long and 20 inches wide.

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Question 3-b. Use the graphing calculator to graph the function and trace to find the maximum volume. Record your findings below.

Question 4. Repeat the procedures in 3-a and 3-b for a sheet of cardboard that is four feet wide and 40 inches long. Record your findings below.

A Visual Glossary of Dihedral and Cyclic Symmetry

by

Lee Reamer

Grade Level/Subject: High School Geometry

Objectives: Given examples of tessellations, the student will identify the dihedral and cyclic symmetries involved.
Given tessellation templates and plain paper, the student will draw symmetries D1-D12 and C2-C12.

Materials Needed:

Tessellation templates
Plain white paper
Examples of previous students' work
Real world examples of tessellations

Preparation of Materials:

Have examples displayed where they can be easily observed or referenced by students.

Directions:

Students begin in teams of four and go through a gallery tour to observe and discuss symmetries involved in each of the examples displayed.

Using tessellation templates, students will produce line drawings illustrating symmetry, D1-D12, and cyclic symmetry, C2-C12.

Students will cut and paste line drawings to make a symmetry glossary. (This is part of a long-term symmetry portfolio project including thematic collections of symmetry, chosen and identified by the student as well as a journal entry reflecting on how examining symmetry helps in developing geometry principles.)

Solving Max-Min Problems in Algebra II

by

Alex Bezjak

Materials/Equipment: Graphing calculator or PC with appropriate software. Graph paper.

Description:

Many times max-min problems are not introduced until, perhaps calculus class. Therefore most students (who do not take calculus) do not receive instruction on this topic. Using a graphical solution, this topic can be introduced in Algebra 2.

Problem:

A closed tin can having a volume of 27 cubic in. is to be made in the form of a right circular cylinder. Find the radius and height of the can so that a minimum amount of material is used to construct this container.

Solution:

The key-strokes for a solution on the TI-82 are on the next page. To solve graphically, we need to write a function for surface area (let x=radius), height, and surface area (let surface area = y).

To get this function we see that surface area equals 2*p*R2 + (circumference)*(height). To develop this relationship, remember V=(area of base)*(height); therefore 27 cubic in. (given volume)=p*R2*H so 27=pR2H and H = (27)/(pR2) or H=(27)/(px2). Also note circumference = 2pR (or C=2px). Therefore, circumference*height reduces to (54)/x. Finally our two-variable function is Y (surface area) =2px2 + (54)/x. This problem can, of course, be solved without a graphing calculator. A scientific calculator and graph paper can yield the same result.

Using the TI-82:

Here are the key-strokes to use the TI-82 to solve the max-min problem. After turning the calculator on, try these keys:

Window Values: Press WINDOWS and try X(-2,10) with Xscl =1. Also try Y(-5,100) with Yscl=1.

Mode selections: Press MODE and select all options on the left side--we want to be in the function mode.

To enter the equation, press Y= to get to the screen to enter the function. Try these strokes:

2
2nd ^
X,T,O
X2
+ (54/X)

The function Y=2px2 + (54)/x. should be in the calculator with those key-strokes. Now press GRAPH which should present on the screen, for the given range, a curve which represents the surface area of the right circular cylinder.

To find the radius (x value) which gives the least surface from the graph, try 2nd TRACE which gives the CALCULATE menu. Select 3: minimum which will allow the coordinates (x, y) of the minimum value to be found.

See Appendix for additional key strokes.

Alex Bezjak
Mathematics Department Chairman
Wickliffe High School

Here are the key-strokes to use the TI-82 to solve the max-min problem. After turning the calculator on, try these keys:

Window values: Press [WINDOW] and try X(-2, 10) with Xscl=1.

Also try Y(-5,100) with Yscl=1.

Mode selections: Press [MODE] and select all options on the left side - we want to be in the *function* mode.

To enter the equation, press [Y=] to get to the screen to enter the function. Try these strokes: [2] [2nd] [$\wedge$] [X,T,θ] [X^2] [+] [$\frac{54}{X}$]. The function $Y = 2\pi X^2 + \frac{54}{X}$ should be in the calculator with those key-strokes. Now press [GRAPH] which should present on the screen , for the given range, a curve which represents the surface area of the right circular cylinder.

To find the radius (x value) which gives the least surface from the graph, try [2nd] [TRACE] which gives the **CALCULATE** menu.

Select [3:minimum] which will allow the coordinates (x,y) of the minimum value to be found.

Displacement, Velocity and Acceleration in Advanced Placement Calculus

by

James E. Kozman

Grade Level/Subject: 12th Grade

Objectives: Students will be able to use the Calculator-Based Laboratory System (CBL) from Texas Instrument to collect data concerning the displacement, velocity, and/or acceleration of an object.

Materials Needed: TI82 graphing calculators (preferably overhead units), CBL unit including sonic motion detector, meter stick, and masking tape.

Preparation of Materials: The calculator will need to be programmed to run the CBL. All necessary programs can be found in the CBL System Experiment Workbook that comes with the CBL unit, or Exploring Physics and Math with the CBL System Chris Brueningsen and Wesley Krawiec, Texas Instruments Incorporated, 1994.

I was able to have three work stations located in the class. This included the TI-82 with overhead and CBL, sonic motion detector, meter stick and a straight line pathway taped on the floor.

The program that I used generated distance-time plots. Various options can be seen at the left.

Directions: Prior to using the CBL System in the classroom I held a "training session" for three students who then became lab assistants. Each assistant learned how to set up the CBL System, including the overhead, and how the necessary programs operated. I divided the class into three groups of five and one lab assistant. Each student was given a laboratory worksheet which contained particular experiments to be conducted.

Activity One:

The focus here is to familiarize students with the CBL, and its operation as related to distance-time graphs. Initially students select MOTION MENU and option 1 from the screen below:

MOTION MENU
1:MOTION
2:MOTION(RLTIME)
3.D-T MATCH 1
4:D-T MATCH 2
5:QUIT

This selection requires a student to walk backward and forward in a straight line path in front of the detector. The motion is then plotted in real-time. That is, a distance-time graph is generated and displayed as the student walks. An example can be seen at the left. Once students were comfortable, they were to predict the distance-time plot for problems given specific directions and then verify by actual experimentation.

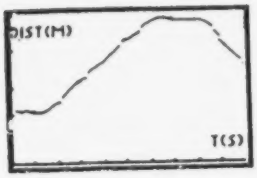
EXAMPLES: 1. Walk away from the detector slowly and steadily.
2. Start at 2 meters. At a steady pace walk away for 2 seconds, stop for 2 seconds, then walk towards the detector.

Option 3 and 4 on the MAIN MENU provides students the opportunity to match their understanding of distance-time plots. This is done by trying to trace over a calculator generated distance-time plot while moving in front of the motion detector.

James Looks Back

Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
Without question the use of the CBL and graphing calculator was helpful. The power of visualization coupled with the ability to conjecture and experiment, really helped solidify, in the minds of the students, the relationships between acceleration, velocity and motion along a line.See the Appendix for other activities.

ACTIVITY ONE:



The focus here is to familiarize students with the CBL and its operation as related to distance-time graphs. Initially students select MOTION MENU option 2 from the above screen. This selection requires a student to walk backward and forward in a straight line path in front of the detector. The motion is then plotted in real-time. That is, a distance-time graph is generated and displayed as the student walks. An example can be seen at the left. Once students were comfortable, they were to predict the distance-time plot for problems given specific directions and then verify by actual experimentation.

EXAMPLES: 1. Walk away from the detector slowly and steadily.

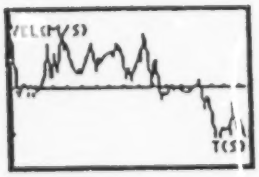
2. Start at 2 meters. At a steady pace walk away for 2 seconds, stop for 2 seconds, then walk towards the detector.

Options 3 and 4 on the MAIN MENU provides students the opportunity to match their understanding of distance-time plots. This is done by trying to trace over a calculator generated distance-time plot while moving in front of the motion detector.

ACTIVITY TWO:

This activity entails ideas involving velocity and acceleration.

EXAMPLES: 1. What kind of graph is expected when walking at a steady pace ?



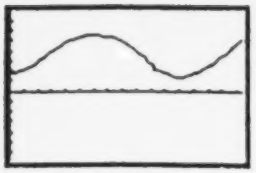
2. What happens if you speed-up and slow-down ?

3. Can you make the distance-time plot form a curve ? If so, explain how.

After making predictions relating to these questions students then had to experiment to test their conjectures.

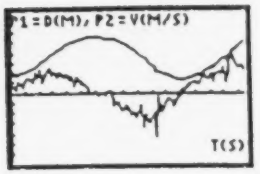
A selection under options 1 or 2 of the MOTION MENU allows for a velocity-time graph, or position-velocity-time graph, which provides the opportunity to study relationships between position and velocity. To the left is a position graph

that was generated, and below is the combination of position and velocity. After collecting several sets of position-velocity-time graphs students worked on the following types of questions:



1. What does the velocity graph tell you about the position graph when the velocity is above (or below) the x-axis ?

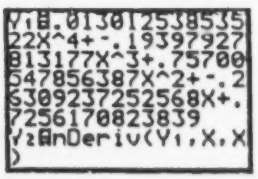
2. When the velocity is zero where are you in relationship to the motion detector ?

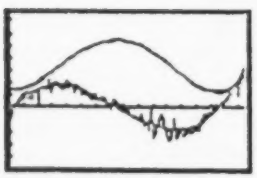


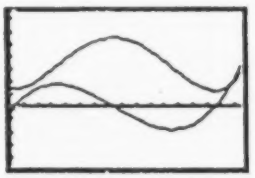
3. What connection, if any, can be made to the position graph when the velocity is at is maximum and/or minimum ?

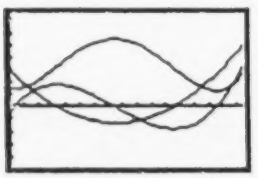
ACTIVITY THREE:

One particular position-velocity-time graph that was generated allowed for the use of the STAT features of the calculator. This data via the LINK was sent to all students. Using the appropriate LISTS and the QuartReg of the calculator's STAT menu gave the regression equation as seen at the left below. In addition, y2 has the derivative of y1. The second picture is an overlay of the data plots of the distance-velocity-time and y1-y2. Picture three shows just y1 and y2. In y3 we put the second derivative of y1. y1, y2, and y3 (acceleration) are graphed together in the last picture.









After completing the above exercise each group was to develop their own example complete with a regression equation and graphs. This provided three examples for study, the purpose of which was to find how the acceleration and velocity graphs can be used to describe the position graph.

Area Approximations in Calculus
by
Susan Kay Troyer

Grade Level/Subject: 12th Grade/Calculus

Objectives: The student will:

1. Use common geometric shapes (i.e. rectangles and trapezoids) to approximate the area under a curve.
2. The student will recognize how limits and integrals aid in the calculation of the area under a curve.

Materials Needed: Fruit by the Foot, Plastic Knives, Rulers, Photocopy of Region

Preparation of Materials: Create packets from the above materials (1 pack of Fruit by the Foot, 1 Plastic Knife, Photocopy of Region).

Directions: Explain to students the task at hand--namely approximating the area of a given region.

Explain the contents found in each packet. Students are to use the second copy of the region to demonstrate their approximation.

Assign students to groups of two or three members each.

Allow 30 minutes for the completion of the task.

Collect data from individual groups--each group should present the process used to obtain their approximation of the area.

Compare approximations with the area obtained by the method of integration. Do NOT disclose the integration technique.

Follow-Up Activities:

Assign students the task of improving the approximations obtained during class.

If necessary, ask students how limits and integrals could be used to simplify the work.

Present notes on how to calculate the area of a region using Upper/Lower Sums.

Susan Kay Looks Back

1. Describe your students' reaction/response to your selected project.
The students were extremely frustrated by the assigned task. They failed to see the association between the rectangular shape of Fruit by the Foot and the given region. Many students shut down and refused to participate in the activity.

2. Do you feel the activity you chose was helpful in reinforcing the mathematical objectives? Why or why not?
Despite the many frustrations, the students understood Riemann Sums and Upper/Lower Sums better than did students from previous years. The activity also reinforced the concept of infinity - due to the fact that the approximation became more accurate as the number of subdivisions increased.

3. What if any revisions would you make to your project in the future?
The scale on the photocopied region should match the dimensions of Fruit by the Foot.

4. If you ordered special materials, pleas give the address and approximate cost of each item.
None.

5. What problems could one expect when they try your lesson plan with their students? How can these situations be facilitated?
If the students are unfamiliar with "hands-on" activities, this activity creates a lot of frustration. Also, the groups need to be small (2-3 people) so that all students have a chance to contribute to the solution.

6. Other comments.
Another consideration is the student who reads ahead in the text. The activity loses its meaning if the student has looked ahead and found Upper/Lower Sums in the text.

Donuts and Mathematics
by
Bill Bagwell

Editors' Note: In a letter addressed to Nancy, Bill explained that he used his award to buy doughnuts for the 30-40 students who come to school an hour early the past few months to participate in various math contests. He admitted that he could not accept the monies for this reason. However, with good reason, OCTM returned the check to him. There is something very special about what Bill Bagwell does with and for his students. All the doughnuts in the world would not bring some students to school so they may participate in a math contest. We share with you part of Bill's letter to Nancy, the spectacular results of his efforts, and evidence of his commitment to quality through his alumnae forms. Surely Bill is a caring, competent teacher and most deserving of the award and monies.

Nancy and Joanne

"To me teaching is many little things: doughnuts, a birthday card, a chance to guess which door has the coveted 'Kovonia' shirt, taking a student to lunch, making balloon animals. All these things take time and money and parents of present and past students along with a few local companies make donations for these needs to be met."

Bill Bagwell

See the Appendix for awards and alumnae survey.

9). How would you rate your high schoo. mathematics background compared with the background of other students at your college? (1-5) _____ 1-poor, 2-below average, 3-average, 4-above average, 5-outstanding

10). What areas covered in high school most prepared you for your freshman course in college? (e.g. derivatives, integration, story problems, graphing, trig, conics, etc.)

_____

_____

_____

_____

_____

_____

_____

_____

_____

11). What areas were not emphasized enough in high school in order to better prepare you for your freshman mathematics courses in college? _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

12). Please include any additional comments or thoughts you would like to make.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

13). Your name (Optional) _____

What college are you attending? _____

What is your major field of study? _____

Please mail to, or have this survey dropped off at: Beavercreek High School
C/O Mr. Bill Bagwell
2660 Dayton-Xenia Rd.,
Xenia, Ohio 45434

We thank you for your time,

W. Bagwell, M. Denlinger, J. Caldwell, M. Wheelock

DEPARTMENT OF MATHEMATICS
BEAVERCREEK HIGH SCHOOL
2660 Dayton-Xenia Road
Xenia, Ohio 45434

Dear Beavercreek Alumnus:

We need your assistance. While at Beavercreek High School, you were enrolled in one or more of the mathematics courses listed below. We are trying to follow up on how well these courses helped to prepare you for your freshman mathematics courses in college. Please take a few minutes of your time to respond to the following questions.

1). In what school year e.g. 88-89) did you take:
_____ A.P. Calculus
_____ Scholarship Analysis and Calculus
_____ Honors Algebra III and Trigonometry II
_____ Scholarship Algebra III and Trigonometry II
_____ General Algebra III and Trigonometry II

2). When did you take the ACT? (month/year) _____
What were your scores? Math _____, English _____

3). When did you take the SAT? (month/year) _____
What were your scores? Math _____, English _____

4). Did you take a mathematics placement test in college? (Yes/No) _____
If so, how well did you do? (1-5) _____ 1-poor, 2-below average, 3-average, 4-above average, 5-outstanding

5). Did you obtain any math credit by examination? (Yes/No) _____
If so, how many hours? (specify by the number of quarter or semester hours)
_____

6). Did you get any math courses waived in college? (Yes/No) _____
If so, which courses? _____
In hindsight, was it a good idea to skip those courses? (Yes/No) _____

7). What was your first math course in college? _____
Textbook/Author/Edition? _____
Did you like the book? (Yes/No) _____
What did you like about the book? _____
_____
_____
_____

What didn't you like about the book? _____
_____
_____
_____

Course grade? _____

8). Have you taken any math courses which required a graphics calculator? (Yes/No) _____
If so, what is your opinion of graphics calculators in a mathematics course?
_____
_____
_____
What kind of graphics calculator did you use? _____

BEST COPY AVAILABLE

• *Math League:* Beavercreek placed in

1992 – Calculus, 16th in the nation.
– Senior Calculator, 1st in the nation.
– Pre – Calculus, 4th in the nation.
– Algebra II, 10th in the nation.
– Geometry, 26th in the nation.
1993 – Calculus, 3rd in the nation.
– Pre Calculus, 4th in the nation.
1994 – Calculus, 9th in the nation.
– Pre Calculus,4th in the nation.

• *Ohio Math League:* Beavercreek placed in

1991 – 2nd in Ohio.
1992 – 2nd in Ohio.
1993 – 2nd in Ohio.
1994 – 3rd in Ohio.

• *Foundations of Scholastic Achievement:* Beavercreek placed in

1992 – 1st in Ohio, 5th in the nation.
1993 – 1st in Ohio, 2nd in the nation.

• *Mandelbrot Math Competition:* Beavercreek placed in

1991 – 1st in Ohio.
1992 – 1st in Ohio.
1993 – 1st in Ohio.
1994 – 1st in Ohio, 10th in the nation.

• *American Invitational Math Exam:* With only the top 1% of the state of Ohio's students qualifying, Beavercreek was represented in

1991 – by 10 students out of a total of 182 students.
1992 – by 14 students out of a total of 178 students.
1993 – by 13 students out of a total of 125 students.
1994 – by 46 students out of a total of 800 students.

Revised 6/2/94

BEAVERCREEK HIGH SCHOOL
MATHEMATICS CONTEST TEAM

• *American High School Mathematics Exam (MAA):* With approximately 25,000 students from 500 Ohio high schools participating, Beavercreek placed in

1991 – 2nd in Ohio.
1992 – 4th in Ohio.
1993 – 1st in Ohio, 10th in the nation.
1994 – 1st in Ohio.

• *Ohio Council of Teachers of Mathematics (OCTM):* With approximately 2,800 students participating from 300 schools, Beavercreek placed in

1991 – 1st in the Miami Valley, 1st in Ohio.
1992 – 1st in the Miami Valley, 2nd in Ohio.
1993 – 1st in the Miami Valley, 1st in Ohio.
1994 – 1st in the Miami Valley, 1st in Ohio.

• *Atlantic – Pacific Math Contest:* Beavercreek placed in

1991 – 1st in Ohio.
1992 – 1st in Ohio, 12th in the nation.
1993 – 1st in Ohio, 10th in the nation.
1994 – 2nd in Ohio, 21st in the nation.

• *American Scholastic Mathematics Association:* Beavercreek placed in

1991 – 1st in Ohio.
1992 – 1st in Ohio, 5th in the nation.
1993 – 1st in Ohio, 5th in the nation.

• *Rose – Hulman Math Contest:* Beavercreek placed in

1991 – 1st, winning 4 of the 8 divisions.
1992 – 1st, winning 4 of the 8 divisions.
1993 – 1st, winning 4 of the 8 divisions.

• *Lakota Math Invitational:* Beavercreek placed in

1991 – 1st.
1993 – 1st, 3rd, and 5th with individuals taking 7 of the top 10 places.

• *Tests of Engineering Aptitude, Mathematics and Science (TEAMS):* Beavercreek placed in

1991 – 1st in the Miami Valley, 2nd in Ohio.
1992 – 1st in the Miami Valley, 1st in Ohio, 6th in the nation.
1993 – 3rd in the Miami Valley.
1994 – 1st in the Miami Valley.

• *Mu Alpha Theta Eastern Regional Mathematics Exam:* Beavercreek placed in

1991 – 1st in the 6 – state region.
1992 – 1st in the 6 – state region.
1993 – 1st in the 6 – state region.